time the sheet of mica being removed, it was found that that part of the paper which it covered retained all its original whiteness, while the rest was wholly of a deep brown colour.

The same experiment has been tried with fine sheets of white mica. Six sheets of common white mica placed on each other did not intercept the chemical rays; the chloride of silver which they covered, at the end of an hour's exposure to the sun, had become quite brown. The same result was obtained after using a single plate of mica, which, however, was still thicker than all the others put together. This substance does not appear to present any obstacle to the transmission of the calorific rays.

These experiments led me at first to suppose that all green substances possessed this property: but I very soon found that this would be drawing too hasty a conclusion; for, having shortly afterwards tried the experiment with a very large emerald, the green of which was very beautiful, though not very deep, and the thickness of which was at least 0.35 of an inch, I found that it readily transmitted the chemical rays. Thus, the matter which imparts the colour to the green emerald has no action on the chemical rays, whilst that which imparts the same colour to glass and mica has great influence over them.

Rock-salt, as might be expected, possesses in a high degree the faculty of transmitting the chemical rays. Glass, too, coloured violet with manganese, and very deep blue glass, such as is common in finger-glasses, likewise very readily transmit these rays. The alteration in the colour of the chloride of silver very speedily takes place in spite of the interposition of a plate of blue glass of the deepest tint, and nearly a quarter of an inch thick.

Among the various substances which I have tried in these experiments, rock-salt and white glass, as also blue and violet-coloured glasses, are those which afford the maximum of permeability to the chemical rays; whilst the green shades of glass and mica present the minimum. Other bodies possess this property in intermediate degrees, and sometimes vary considerably, though the colour is nearly the same. Thus glass of a deep red colour allows very few of the chemical rays to pass, whilst garnet, of an equally deep colour, allows nearly the whole of them to pass. The white topaz, as well as the blue, the pale blue beryl, the cyanite, the heavy spar, the amethyst, and various other substances, transmit the chemical rays with great facility; whilst the yellow beryl does not, so to speak, transmit them at all, and the brown tourmaline as well as the green, have the property in so slight a degree, that I have failed in my attempts to polarize the rays under these circumstances, though I believe it might not be impossible, if thinner plates were used than I had it in my power to employ. In concluding, I may observe, that I purpose shortly to resume the prosecution of the subject.*

Edin. New Philos. Jour.

On the cause of the remarkable difference between the attractions of a Permanent and of an Electro-Magnet on soft iron at a distance. By the Rev. Wm. Ritchie, L. L. D., F. R. S., Prof. of Nat. Phil. Royal Inst., and in Univ. of London.

Attach a piece of soft iron, such as the lifter of a common horse-shoe magnet to one extremity of a slender delicate balance of light wood, and balance it by weights in a scale pan at the other end. Place a permanent

* Would it not be interesting to ascertain by careful experiments, the relative effects of green and white glass shades upon plants, as practised by gardeners. G.

horse-shoe-magnet below it and ascertain its attractive force by weights, both when in contact and when removed to different distances from the soft iron. Remove the permanent magnet and substitute a very *short* electro-magnet of equal lifting power. Remove it to the same distance as before and the attractive power will diminish very rapidly compared with that of the permanent steel magnet.

2. Instead of the short electro-magnet, substitute a very long one (of two or three feet long for example) and of equal carrying power; remove it to the same distances and ascertain its attractive power, and it will be found that its attraction for the lifter will *not* diminish so rapidly as that of the short one. The longer the electro-magnet becomes, the more does it approach to the character of the permanent magnet in all its properties.

3. Make the electro-magnet of *hard* iron or untempered steel and its power at a distance will be much greater than in the electro-magnet of soft iron.

These facts are accounted for by Dr. Forbes, in the following manner:

The perfect equality of *action* and *reaction* must be found to exist in this case as well as in every other in which *force* of any kind is concerned. The electricity which has been decomposed and arranged in the soft iron in the peculiar manner which constitutes magnetism, cannot decompose and arrange the electricity belonging to the lifter without suffering a corresponding *diminution*, and the more difficult the arrangement in the lifter so much greater will be the diminution of power in the electro-magnet. Again, if the electricity in the electro-magnet be easily arranged by the induction of the voltaic helix, it will be easily forced back to its natural state by the *reaction* of that belonging to the lifter. Hence it follows that when the *inducing* power of the electro-magnet is very great (which it is when the lifter is in contact with its ends) it will possess sufficient power to *vanquish* the *coercitive* force of the lifter, arrange by induction a large portion of the electricity of the lifter, and thus exhibit powerful attraction. When the lifter is removed to a certain distance, one-tenth of an inch for example, the power of the electro-magnet being much *diminished* in consequence of the distance, whilst the difficulty of overcoming the coercitive force of the lifter is *increased*, the effect will be very small compared with the former. For if the inducing power be only *equal* to the coercitive force of the lifter, no attraction whatever will take place; and hence the impossibility of magnetizing a large bar of steel tempered as hard as possible, by means of a small permanent magnet with a soft temper.

Now, if the coercitive force of the electro-magnet be increased, which is done either by employing a long magnet, or using hard iron or untempered steel, such a magnet will suffer *less* diminution by the *reaction* of the lifter in the case of increased difficulty of arrangement in the lifter, than in the case of the short electro-magnet of perfectly soft iron.

In the case of the permanent magnet of tempered steel, the electricity belonging to it was arranged with *difficulty*, and after repeated *touches* of another magnet, and consequently it will easily vanquish the coercitive power of a piece of soft iron, and induce a magnetic state upon it, whilst the peculiar arrangement of its own electricity will remain nearly *unchanged*. Hence its *attractive* powers will diminish *nearly* as the squares of the distances of the soft iron from its poles, or *imaginary* centres of accumulation, a law which cannot exist in the case of the electro-magnet the electricity of which is so easily put in motion round the elementary molecules of the iron by the reaction of the lifter. Lond. & Ed. Philos. Mag.